Art. VII.—*The Geology of Coimaidai.*

Part I.

The Coimaidai Limestones and Associated Deposits.

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The geological interest of the district of Coimaidai arises from the occurrence there of (1) magnesian limestones containing mammalian bones, and of (2) glacial deposits. Some of our conclusions concerning the latter beds have been already given in a paper read at the last meeting of the A.A.A.S. at Brisbane. In the present paper only the limestones and other formations associated with them will be dealt with.

The area under description is situated in the parishes of Merrimu and Coimaidai, County of Bourke, and lies a few miles north of the town of Bacchus Marsh; it is included between the Lerderderg River on the west and south and the Djerriwarrah Creek on the east, while northwards it extends some miles towards Mount Bullengarook. In addition to the two streams mentioned, several creeks, flowing in a southerly direction, traverse the area, exposing many good sections along their courses. The principal creeks are Goodman's Creek, Boggy Creek, and Pyrete Creek. It is in the valley of the latter creek, in the vicinity of the township of Coimaidai, that the limestones are best exposed. The area of the district is about thirty-six square miles.

The formations developed in the district are, in ascending order—

(1) Lower Silurian.
(2) Permo-carboniferous Glacial beds.
(3) Coimaidai limestones, gravels, conglomerates, etc.
(4) Newer Basalt.
(5) Post-Tertiary and recent beds.

The deposits described in the present paper are those contained in the three last groups of the above list.

With regard to the previous geological work in this district we are informed by Mr. Stirling, Government Geologist, that surveys of this part of the country were executed many years ago by the Government officers, but the results were never published, and all trace of them appears to have been lost. The only published account of the geology of Coimaidai is a short report by Mr. Ferguson, Assistant Government Geologist, contained in the Mining Department Progress Report, No. VIII., 1894. Mr. Ferguson gives a sketch map and sections, reference to which will be made further on.

As already mentioned, the limestones are best studied in the neighbourhood of the township of Coimaidai. On the eastern side of the Pyrete Valley, opposite Mr. Bennett's hotel, are two large quarries, Alkemade's and Bennett's, in which splendid sections are exhibited; a third and smaller quarry (Burnip's) occurs on the west side of the valley. The material quarried is a magnesian limestone, used for the manufacture of lime and hydraulic cement. It is in this formation that the mammalian bones have been discovered which give to these beds their peculiar scientific interest. The bones already found included fairly well preserved jaw-bones of the kangaroo and wombat, fragments of jaw-bones of a macropoid type, and portions of long bones.

The writers of this paper are in communication with Mr. C. de Vis, M.A., of Brisbane, with a view of obtaining from him a detailed description of the bones in their possession, and also of those collected by Mr. Ferguson, which have been kindly placed at their disposal for this purpose by Mr. Stirling, Government Geologist. It may here be mentioned that bones and fragments have been obtained *in situ* by each of the writers under circumstances which entirely preclude the supposition that the bones found by them may have made their way in comparatively recent times to the positions in which they were discovered by means of earth-cracks or fissures. The entombment of the bones certainly took place contemporaneously with the deposition of the enclosing sediments.

In view of the importance attaching to the discovery of mammalian bones in Victoria, somewhat detailed accounts will be given of the deposits in which they occur. The floor on which the limestone quarries rest is not visible, but from an examination of the surrounding strata the bed-rock is clearly either the glacial boulder clay or Lower Silurian: almost certainly the latter in the case of Burnip's quarry.

The series exposed in the quarry sections consists mainly of magnesian limestone, with intercalated beds of calcareous sand, grit and gravel. They are well stratified, especially towards the upper part of the sections. The several beds exposed have undergone a considerable amount of disturbance and contortion; they have a general dip in towards the bottom of the valley, the average dip being about 20°, although angles of 30° have been noted.

There can be little doubt that the cause of the disturbance and contortion of the beds is to be found in the character of the beds themselves. By the solvent action of percolating waters caverns and hollows have been formed in the limestone; at a later stage subsidence has taken place in, as might have been expected, a more or less irregular manner. In places where a band of clay adjoins a limestone bed it may be noticed that the clay has been forced into cavities dissolved out of the limestone; the effect of this intrusion of the clay is to give an appearance of unconformity, which is, however, at once dispelled by a more complete study of the sections. In connection with this matter it may be noticed that the lowest points to which the quarries have been worked are still at a moderate height above the level of the creek draining the area.

Section at Alkemade's Quarry.

All the beds represented cannot be seen exposed in one face, but by following out the strikes and dips the following section has been constructed, showing the relative positions of the various beds and their approximate thickness in each case.

In descending order we have :—

(1) Gravel and ferruginous conglomerate, 8 feet.

(2) Very fine blue clay, interspersed with finely-laminated limestone shales of varying texture and hardness, and containing lenticular masses of hard, compact

limestone, 10 feet. The clay bands vary much in thickness and show considerable disturbance.

(3) Yellowish limestone, soft as a rule, but containing lenticular bands of hard limestone, 6 feet.

(4) Thin bed of ash, 6 inches. This stratum varies in thickness from two inches to one foot. In marked contrast to the individual beds of the series, it has a wide distribution; it has been picked up on both sides of the valley, and constitutes a valuable bench mark.

(5) Yellowish white limestone of varying texture and hardness; it is honeycombed in places, 6 feet.

(6) Gravel and calcareous sand, 12—15 inches. The gravel is mainly quartz, but fragments of neighbouring Silurian rocks are frequent. The pebbles composing it are somewhat angular as a rule.

(7) Calcareous sand, 3 feet. It is somewhat soft, but merges into harder calcareous bands in places. It is from this bed that the mammalian bones have been for the most part obtained.

(8) Grit, sand and gravel, more or less calcareous, 1 foot 8 inches.

(9) Soft, earthy and gritty limestone, passing into a harder, somewhat ferruginous, material containing lenticular masses of hard, compact stone, 6 feet.

(10) Hard, compact limestone, very fine-grained in places, in others gritty, with quartz grains. The colour varies from a fawn colour to white or bluish-white, the rock of the latter tint being exceedingly fine-grained. About two feet of this bed is exposed; it is the lowest to be seen in the quarry. We were informed by the Messrs. Alkemade that they sank a shaft for about thirty feet through this stratum without reaching the bed-rock.

The thickness of the section we have constructed may be taken to be about forty-four feet, and if the thickness of the last-mentioned bed be taken at twenty-six feet, a total thickness of seventy feet in round numbers for the whole series is obtained. The thickness of rock above the bone bed is about thirty-three feet six inches. Magnesite filling in fissures occurring in the limestone is found in large quantities.

The details of the section of Bennett's and Burnip's quarries are omitted, as no bones have been obtained by us here. Their general character is very similar to that of Alkemade's quarry; the ash-bed previously referred to is shown in each quarry.

The only other fossil remains yet found in these quarries are vegetable; though abundant, they are extremely fragmentary. They appear to be mostly fragments of grasses and perhaps characeous plants. Some of the limestones are traversed by innumerable minute branching perforations, often coated with a thin pellicle of iron oxide, which may possibly be casts of rootlets of plant life. Other branching forms are found, but they are very indefinite in character. One fragment of a fern has been obtained. A microscopic examination of thin sections of the limestone reveals minute spherical bodies, which may possibly represent the spore cases of characeous plants.

Leaving the quarries, in which the main development of the limestone occurs, we proceed to trace their stratigraphical relation to the other formations of the district. Along the eastern side of the Pyrete Valley and towards its head the limestone can be seen outcropping in several places, the apparent dip in each case being into the valley. At one place, a quarter of a mile from Bennett's quarry, where a small cut has exposed the limestone, the ash band before referred to is to be again seen.

A short distance above this latter point, as one ascends the hill in a south-easterly direction, an extensive outcrop of an intensely hard quartzite is met with, and towards its base this formation appears to gradually pass into a softer rock which contains both lime and magnesia. In this rock small segregated veins and patches of a highly silicious nature are frequent. The quartzite varies considerably in texture, being very fine grained and almost cherty in places, while in others it is much coarser and merges into a quartzitic grit and conglomerate.

Passing on up the hill beds of more or less cemented sand, gravel and ferruginous conglomerate are encountered, the uppermost being chiefly of the latter material. A remarkable feature is the great variability in texture of these beds, some being intensely hard, while others are soft and incoherent. The ferruginous cementing material appears to be often replaced by silica, and all the harder cemented rocks seem to have the form of lenticular sheets, varying much in extent. On the other side of this hill, remote from the quarries and close to the Melton Road, an outcrop of limestone is seen in a small gully; it is overlain by ferruginous rocks, and has an apparent dip in a north-easterly direction. Along the road from Coimaidai to the Bullengarook Road outcrops of sandstone, gravel and conglomerate occur; the topmost beds, which lie directly under the basalt, are about 240 feet above the base of the quarries. It is thus seen that, in the vicinity of Coimaidai, the limestone is overlain by series of sands, gravels, quartzites and conglomerates, the bed superposed on the limestone being different in different places. That the limestone of the quarries is older than the associated beds, and does not occupy a valley of erosion in them, is clear to the writers from the following considerations:—

(1) Its apparent position with regard to the overlying beds.

(2) The absence of either rounded or unrounded fragments of grit, quartzite, or conglomerate in the limestone, or gravels intercalated with the limestones in the quarries.

It is indeed fortunate that the evidence on this point is clear so far as the quarry limestones are concerned, as in other parts of the district the relation of the limestone to the other beds is inverted; for instance, at a point about two and a half miles below Coimaidai, on the west side of the Pyrete valley, a section is exposed in which we find in descending order:—

(1) Basalt.

(2) Limestone, containing abundant freshwater shell casts, which, in the opinion of Mr. C. Hedley, F.L.S., are mostly of the genus Limnæa. One Bulimus was found.

(3) Clay, sand, gravel and conglomerate, merging into quartzite.

About a quarter of a mile higher up the quartzite is well developed and rests directly on the Silurian rocks.

The limestone in the above section is essentially of the same composition as the quarry limestone, being mainly carbonate of lime and magnesia, with a little silica, alumina and iron oxide. It is also very similar in physical appearance. Moreover, the gravels and quartzites overlying the limestone here cannot be distinguished in appearance from the similar beds seen near the quarries. It would thus appear that the limestone cannot be regarded as confined to one horizon. Mr. Ferguson, in the map above referred to, represents the quarry limestone as being overlain with a strong unconformity by the gravels, quartzites, etc. With this conclusion we do not agree; the limestone must be regarded as part and parcel of the beds with which it is associated.

These deposits can be traced down the Pyrete Valley, outcropping just below the basalt; and though they vary considerably in character from point to point, we have no doubt that they are continuous. As we leave Coimaidai and approach the Bacchus Marsh side of the basalt edge, the beds are found to be, as a rule, less highly cemented, and therefore looser and more incoherent.

On the Bacchus Marsh side, pipe-clays of a beautifully white colour and pure nature begin to appear. They are associated with considerable thicknesses of fine white sands, grits and gravels. Here and there a bed of hard conglomerate and thin lenticles of white, compact quartzite can be seen, intercalated with softer and even incoherent deposits. Near the Bacchus Marsh Road, and a short distance below the basalt, thin beds of limestone occur. This limestone is essentially of the same character as the quarry limestone, and its occurrence here is strong confirmatory evidence of the continuity of the beds of the Bacchus Marsh side of the district with those of Coimaidai. At a little distance from this limestone outcrop, and at a lower level, a section has been exposed in a road-cutting, in which we find in ascending order:—

(1) Gravel and sand, 5 feet.

(2) Thin band of white pipe-clay containing leaf impressions.

(3) Gravel and sand, showing much false bedding, 8 feet.

The leaf impressions are somewhat fragmentary, but of such distinctive character as to leave no room for doubt as to their significance. One impression is very similar to that of *Laurus* *werribeensis.* This band is at the lowest point in our series, the first appearance of limestone being about 130 feet above it. The relation of the Coimaidai series to the well-known Bacchus Marsh leaf beds is a point of great importance, especially as Messrs. Hall and Pritchard and Mr. C. Brittlebank have advanced strong evidence that the latter beds are at least of Eocene, if not of Cretaceous, age. Between the sands, gravels and ferruginous beds of varying character forming the Bacchus Marsh leaf beds and those of the Coimaidai area there is a very strong lithological resemblance. The absence of leaves from the Coimaidai series is, however, so marked a feature that, in our present knowledge of the facts, we are inclined to regard the Coimaidai series as lying above the Bacchus Marsh leaf beds. Except for the non-discovery of leaf-impressions, we have no evidence to show that there is a break or discontinuity between the Coimaidai and Bacchus Marsh series. On the contrary, our sections would seem to show that there is a gradual passage from the pipe-clay, in which we found our only leaf-casts, and which we regard as on the horizon of the Bacchus Marsh leaf beds, into the overlying series. In the Quarter-sheet of the Geological Survey, Section 12 N.E. Bacchus Marsh, a small part of the district we have been investigating is included, and here the infra-basaltic beds are mapped as identical with the leaf beds, a circumstance which corroborates the view we have taken of the mutual relations of the two series.

Before proceeding to discuss the physical condition which obtained during the formation of the Coimaidai beds, attention must be drawn to the existence of an ancient river-bed which has played an important part in determining the present contour and aspect of the country. The course of this river is, in the northern part of our district, mainly coincident in position with the tongue of basalt which separates the Pyrete and Goodman's Valleys. As it is a gold-bearing lead, many tunnels have been driven into it, and, both from the surface outcrops and the drifts exposed in the tunnels, we surmise that the river was of some magnitude. Some of the boulders of quartz seen by us are several feet in diameter, and well rounded and waterworn, as though they had travelled a considerable distance. The river course is through Silurian strata, and the river-drift is quartz and other rock of Silurian aspect. The existence of this river on the ridge between the deep valleys of the Pyrete and Goodman's Creeks testifies to the amount of denudation which nas taken place here in post-basalt times. The sides of the pre-existing valley of the river, which guided the basalt flow, have entirely disappeared at a point quite 500 feet above the creeks on either side of the ridge.

With respect to the physical circumstances under which the Coimaidai series was formed, it is clear that these beds accumulated under fresh water conditions, fluviatile and lacustrine. A large depressed area existed in the Bacchus Marsh district, in which was a lake resting on Silurian and Glacial beds. The shore line of the lake was doubtless irregular, and one large indentation extended up to the Coimaidai district. The deepest part of the lake was towards Bacchus Marsh, but in the region of the present valley of Coimaidai was a basin of considerable depth. Into this lake the ancient river previously referred to flowed in a southerly direction, accumulating, probably with the help of other streams, the masses of gravel and drift we now see. The main current of the river seems to have been towards the west side of the plain, although heavy boulder drift on the west of the Pyrete indicates that either a channel of the river came that way or marks the course of other creeks emptying into the lake. A spur of Silurian, probably forming a bold promontory, seems to have sheltered the Coimaidai Bay from the main flow of the river, and in this bay special conditions appear to have obtained. The regular stratification and fine lamination of the limestones imply fairly still water continuing during a considerable interval of time. Certain pit-marks, which may have been caused by rain, in the limestone suggest that there may have been variations of the level of the lake, by which expanses of the bed may have been exposed.

The limestone is a dolomitic travertin, and undoubtedly of chemical origin. Lime and magnesia, in solution in the waters of the lake, have been precipitated as carbonates, probably by springs of CO_2. In this context it may be mentioned that springs of CO_2 are at the present day abundant along the course of the Pyrete Creek, and in every case in which we have noticed them the bed-rock from which they issue has been either Glacial or Silurian. Their origin and maintenance would, therefore, appear to be quite unconnected with the decomposition of the limestone. The irregular and patchy distribution of the limestone is, therefore, what might have been expected on this view of their origin, as the springs would in all probability be quite local and even of an intermittent character. The band of ash found in the quarries suggests that the volcanic activity, which was manifesting itself during the deposition of the limestone, may not be unconnected with the development of the CO_2 springs. This point, however, we do not urge, in view of the fact that the springs still continue long after the cessation of the volcanic activity. It is, perhaps, worth while noticing in this context that the course of the Pyrete Creek roughly agrees with the strike of the Silurian rocks in this locality.

The intercalated bands at the quarry of sand and angular quartz gravel indicate that freshets occurred in the streams emptying into the lake in this region, and the fact that only isolated bones have been discovered suggests that the bones were brought down by streams to their final resting place.

The very hard quartzites appear to have been formed by the action of silicious springs. The microscopic examination of the rock strongly confirms this view ; in the slide rounded and subangular grains of quartz are set in a matrix of extremely minute specks of quartz, which acts as a cementing material. The peripheral markings of some of the quartz-grains may possibly be explained on the supposition that there has been a growth of the quartz by its taking up some of the silica in solution. There is a good deal of black dust, probably magnetite, scattered through the slide, and it is quite possible that, to some slight extent, the grains are bound together by a ferruginous cement. A few highly refracting and brightly polarising grains visible in the slide indicate, in all probability, the presence of zircons. There is no trace of felspar among the grains.

Only in this way do we think that the presence of hard, cherty quartzite in the midst of incoherent sand can be explained. The existence of wood opal in the river gravel supports the view that silicious springs occurred in the district. The sediments ultimately filled the Coimaidai basin and spread away to the eastward, where a wide extent of ferruginous sands and conglomerates form a more or less flat country, which extends to the Djerriwarrah Creek. Here the beds are found resting directly on the Silurian rocks.

With the exception of the basalt, the remaining post-glacial beds do not call for extended notice. Along the Goodman's Creek they are represented by a great development of boulder drift, often very heavy, and gravel. A ferruginous conglomerate is met with at different levels; the highest beds of this, which rest directly on the glacial rocks, are possibly continuous with those east of the Pyrete Creek. In the absence of fossil evidence, and having regard to the great variation of lithological character which marks the tertiary beds of this district, no attempt can be made to collate these beds with those lying further west.

On the south-east extremity of the basalt there is a thin capping of sand and water worn gravel, similar in composition and having the same level as the gravels found S. and S.E. of Bacchus Marsh, and well exposed in the Railway cutting S.E. of that town.

Basalt.—The point of eruption of the basalt flow was Mount Bullengarook, some seven miles to the north of the township of Coimaidai. The basalt is almost entirely confined to the area between the Goodman's and Pyrete Creeks, only one outcrop, and that a very small one, having been noticed by us west of the former creek, and no outcrop east of the latter creek. The basalt enters our district at an elevation of about 1100 feet above Coimaidai, and its thickness here is approximately 250 feet. At this spot it is about 300 feet wide, with a small slope to the south. This breadth is maintained fairly constant for a considerable distance south, but at a point on the Bullengarook Road, some 460 feet above Coimaidai, it rapidly narrows. At this place it is only forty feet wide and a few feet thick. Directly after leaving this spot, locally known as "The Neck," the basalt widens out into a broad plain, which, with a slight southerly slope, extends to the boundary of our area, where it has a thickness of between thirty and forty feet.

From its position and character we think that the basalt found west of the Goodman's Creek came from Mount Bullengarook. If this is so the creek must have eaten its way through some hundreds of feet of rock to attain its present level. Attention has been drawn to the connection between the basalt flow and the ancient river valley of the district.

The physical relations of the basalt to the other formations do not offer any points of particular interest. In places we have found the subjacent rock showing signs of metamorphism at its junction with the basalt. At a point a few yards east of Holloway's tunnel the basalt contains included pebbles of quartz and quartzite similar to those found in the river drift ; at the junction of the Coimaidai and Bullengarook Roads unrounded fragments of sandstone are found in it, while at its southern boundary it contains pieces of slate, etc.

A large number of specimens of basalt from different parts of the district have been prepared for microscopic examination. The general result of the examination shows that the rock may be classed as an olivine basalt with, however, a somewhat varying character. The specimens sliced from the neighbourhood of Coimaidai and south of Coimaidai contain large eroded crystals of felspar of allogenic origin, while olivine is somewhat subsidiary. As we proceed towards the northern boundary of our area the allogenic felspar disappears, and the rock becomes very rich in olivine. In other slides a further disappearance of authigenic felspar may be noticed until the rock assumes the type of limburgite. Some of the specimens have been tested for titaniferous iron, but with a negative result.

In macroscopic structure the basalt shows the usual variability, passing by stages from a hard, dense rock into the vesicular form. Magma-basalt, much weathered, was found near the limburgite.

Slide No. 1 is cut from basalt taken from the eastern edge of the plateau, about a quarter of a mile due west from the township of Coimaidai. In appearance it is a dense rock, of bluish-black colour, breaking with a somewhat hackly fracture. Porphyritic crystals of felspar, olivine and secondary calcite may be seen by the naked eye. Under the microscope the rock is seen to possess a hyalopilitic structure ; there is a considerable amount of glass or isotropic matter present, which has in natural light a faint brown colour. The other minerals present are triclinic felspar, augite, olivine, magnetite and secondary calcite. The felspar occurs in two distinct forms, of allogenic and authigenic origin. The allogenic felspar is present as large phenocrysts which have suffered much erosion; around them the lath-like felspars of authigenic origin are arranged in flow-structure. In natural light the allogenic felspar is seen as a clear and colourless material, containing inclusions of a light brown colour, and magnetite. As these inclusions are isotropic in character, it would appear that during the intra-telluric stage in the history of the crystal the solvent action of the magma produced a honeycomb structure in the felspar, and that the cavities so produced were filled with basalt glass, from which the magnetite has subsequently crystallised out In one phenocryst both the glass inclusions and the magnetite appear arranged in lines along the twinning planes. The phenocrysts show twinning according to both the albite and pericline laws; but no sections are present in the slide from which measurements could be taken to determine the nature of the felspar. The authigenic felspar occurs in sections of short, broad prisms and in lath-like forms, which are sometimes frayed out at one end. From measurements taken by us, this felspar is probably labradorite. Augite is moderately represented in the slide; it occurs mainly in allotriomorphic crystals, which often form nests or clusters. These clusters give a striking appearance to the slide. The masses of augite are destitute of crystal boundaries; their composite character is shown by the fact that, under polarised light, different parts of the aggregation do not obscure simultaneously. These clusters contain numerous, somewhat large, grains of magnetite. In this slide there is a good example of twinned augite showing the hour-glass structure. Olivine is fairly abundant as hypidiomorphic crystals and as grains wedged in between the lath-like felspars; it is, for the most part, decomposed into a light green chloritic or serpentinous material. The magnetite and calcite do not call for any special remark. The order of crystallisation of the constituent minerals appears to be allogenic felspar, magnetite, augite and olivine, authigenic felspar and secondary calcite.

Slide No. 2 represents the typical basalt of the tongue-like mass lying between the Pyrete and Goodman's Creeks. It has been prepared from a specimen taken about half a mile north of "the Neck." It has a fine-grained matrix, studded with porphyritic crystals and blebs of olivine. The rock is microscopically holocrystalline, approaching to a pilotaxitic structure. The constituent minerals are felspar, olivine, augite and magnetite. The felspar is in lath-like forms, having their longer axes arranged in more or less parallel lines ; there is some trace of flow structure round the larger phenocrysts of olivine and augite. Olivine is very abundant in the slide, appearing both as allotriomorphic crystals and as grains. The crystals are large and almost entirely free from decomposition. Augite is less abundant than olivine ; it occurs in allotriomorphic crystals, rounded masses and clusters. Magnetite is seen in large quantities, as minute specks often forming a wreath or border round the outer edges of the phenocrysts, as small grains, and in large masses presenting certain peculiar features. One of these masses is not unlike a semi-circle in shape, the side corresponding to the diameter of the semi-circle is between ·02 and ·03 of an inch long, and is a fairly straight line, while the curved edge is deeply fretted and has a lattice-like structure, the minute areas bounded by the thin films of magnetite contain anisotropic matter, probably a devitrified glass.

Slide No. 3 is from a specimen taken from a small outcrop in Langmuir's paddock, about two miles W.N.W. of Coimaidai. This outcrop is the only one found by us west of the Goodman's Creek. Macroscopically it is very similar in appearance to the rock last described, porphyritic crystals of augite, decomposed olivine and a reddish-brown mica may be seen by the naked eye. The base may be classed as hypocrystalline, being made up mainly of grains of magnetite and augite, with residual glass. The minerals present are augite, olivine and magnetite. Felspar is almost entirely, if not quite, absent. Augite is abundant in well preserved idiomorphic crystals, often showing zonal structure. A peculiar feature is exhibited by some of the augite phenocrysts. When the stage of the microscope is rotated between crossed nicols, the crystal is seen to be composite in character, there being a central area and a peripheral area ; the boundary of the central area does not conform to that of the crystal, and the two areas do not obscure simultaneously. The cleavage lines of the inner and outer areas are continuous. The appearance presented is quite dissimilar from that of normal zonal structure, and points to considerable discontinuity in the growth of the crystal. Other augite phenocrysts present peculiarities of another kind ; there is an inner area, often with ragged, uneven boundary, which is clear and colourless in plane light ; this is enclosed in a border of a light brown colour and of varying breadth ; the whole is enclosed in augite showing good crystal outlines. The inner area does not, in general, obscure with the outer area ; it is more highly refracting. The enclosed material is in all probability an eroded augite crystal. Most of the augite crystals show accumulations of black specks towards their central parts. Olivine is present in large crystals, but has suffered much decomposition ; the replacing material is light green in colour and sometimes faintly pleochroic. When decomposition has advanced very far the olivine has been entirely converted into a serpentinous material. There is no mica present in the slide ; in another slide, procured near Mount Bullengarook, there are small patches of a reddish-brown mica, pseudomorph after olivine, which may possibly be rubellan. The mica seen on the surface of the rock from which this slide has been cut appears to occupy a cavity in an olivine crystal. The residual glass is in places traversed by long, colourless, acicular rays. Beyond the fact that they are a common constituent of basalts all over the globe, nothing definite appears to be known of them. Zirkel, in his "Microscopic Petrography of the Fortieth Parallel," regards them as an undetermined product of devitrification. Having regard to the basic character of the rock and the absence of felspar crystals, we have no hesitation in calling it limburgite. The previous occurrence of this mineral in Victoria has been noticed by Mr. A. W. Howitt in a dyke in the No. 180 Mine, Bendigo.
